S-6/PHSH/CC-13/22

TDPH (Honours) 6th Semester

Supplementary Exam., 2022

PHYSICS

(Honours)

PAPER : CC – 13

Full Marks : 60 *Time* : 3 Hours

Answer from ***both*** *the Groups as directed.*

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

GROUP—A

1. Answer *any* **six** questions : 2×6=12

(a) What do you mean by Poynting vector?

(b) What is displacement current?

(c) Write the equation of continuity in electromagnetic theory.

(d) Define skin effect.

(e) State Biot's law of rotatory polarization.

(f) What is double refraction?

(g) What is wave guide?

(h) What do you mean by numerical aperture?

GROUP—B

There are *four* questions from Question No. 2 to Question No. 5. Answer either *(a)* **or** *(b)* from each question given below :

2. *(a)* *(i)* Write Maxwell's electromagnetic equations defining all the terms.

(ii) Show that in a homogeneous isotropic dielectric medium of permittivity ε and permeability μ, electric and magnetic field are in phase.

(iii) Define Lorentz Gauge and Coulomb Gauge. 4+4+4=12

(OR)

(b) *(i)* State and prove Poynting's theorem.

(ii) Show that in case of electromagnetic waves in free space, energy is equally shared between electric and magnetic fields.

(iii) Show that in a harmonically varying electromagnetic field represented by complex rotations, the time average Poynting vector can be represented by real part of $\frac{1}{2}\left(\vec{E}\times\vec{H}^{*}\right)$, where $\vec{H}^{*}$ is the complex conjugate of $\vec{H}$. 4+4+4=12

3. *(a)* *(i)* Define skin depth of a conductor. Show that as the frequency increases, skin depth decreases.

(ii) What do you mean by characteristic impedance of a dielectric to e.m. wave and calculate the characteristic (intrinsic) impedance of free space.

(iii) Explain total internal reflection on the basis of Fresnel's law of reflection. (1+3)+(1+3)+4=12

(OR)

(b) *(i)* What do you mean by normal and anomalous dispersion? Write down the assumptions made by Lorentz to explain dispersion in gases.

(ii) From the concept of plane e.m. wave, establish the Snell's law of refraction.

(iii) An e.m. wave in empty space has a maximum electric field of 1000 V/m. What is the maximum value of magnetic field? (2+3)+5+2=12

4. *(a)* *(i)* What is birefringence? How does it explain double refraction?

(ii) What is a quarter wave plate? Derive an expression for it's thickness.

(iii) The refractive index of E-ray and O-ray are 1·486 and 1·658 respectively with sodium light of wavelength 589 nm. Find the thickness of half wave plate. (1+3)+(2+4)+2=12

(OR)

(b) (i) Explain the working of Babinet compensator. What is the advantage of using it over quarter wave plate?

(ii) Write the differences between negative and positive crystals.

(iii) Describe how a Nicol Prism can be used to produce and analyse plane polarised light. (2+4)+3+3=12

5. (a) (i) What do you mean by optical activity? On what factor it depends? Explain the reason behind optical activity.

(ii) Explain Fresnel's theory of optical rotation. How can you calculate angle of rotation from it?

(iii) A solution of camphor in alcohol in a tube 25 cm long is found to effect a rotation of the plane of vibration of light through 36°. What must be the concentration of camphor solution? Given specific rotation of camphor is +56°. (1+2+2)+5+2=12

(OR)

(b) (i) Explain the working principle of optical fibre.

(ii) Describe different types of optical fibre.

(iii) Discuss the working of Laurent's half shade polarimeter to find specific rotation. 3+4+5=12

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